

Central Intelligence Agency



Washington, D.C. 20505

DATE 3/16/87 FILE
DOC NO EA M 87-20044
OIR 3
P & PD 1

DIRECTORATE OF INTELLIGENCE

13 March 1987

China's S&T System

Summary

China is in the process of reforming its S&T system in order to improve its capabilities and enhance the S&T community's contribution to other sectors of the economy. The reforms promote economic incentives and market mechanisms to direct scientific work and encourage initiative. They are stimulating some new technology development and transfer activities, but China is having difficulty implementing the changes.

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Priorities

With "S&T serving national needs" as the guiding principle, Beijing is stressing S&T activities that can be applied quickly to meet national development needs. Its research efforts are focused primarily on improving capabilities in selected advanced technologies--integrated circuits, computers, telecommunications, composite materials, biotechnology, automated manufacturing, and energy. A second major S&T program is

This memorandum was prepared by Office of East Asian Analysis. Information available as of 13 March 1987 was used in its preparation. Comments and queries are welcome and may be directed to the Chief, Trade and Technology Branch, China Division, OEA,

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to provide technology and equipment needed to support agriculture and rural industries.

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Organizational Changes

The reforms are changing the way S&T activities are managed in order to overcome chronic problems that have hobbled the system--lack of coordination between organizations, overemphasis on theoretical research, inability to apply research results to production, and lack of incentives for quality performance. Specific changes include altering the funding system, giving more decisionmaking powers to research directors, and better training and working conditions for S&T personnel.¹

At the policy level, Beijing has tried to strengthen coordination and oversight, although the proliferation of groups with similar functions and, in many cases, the same personnel, raises the potential for managerial confusion. A special supraministerial body, the S&T Leading Group, was established in 1983 to coordinate national S&T activities, oversee implementation of the reforms, and improve coordination between military and civilian S&T entities. Another leading group, the Leading Group for the Invigoration of the Electronics Industry, is playing a key role in providing planning and oversight for the integrated circuits, computers, and telecommunications sectors. Other leading groups have been established to guide specific measures such as reform of the job titles system and creation of technology markets. Subordinate to the leading groups are the State Science and Technology Commission (SSTC), which coordinates civilian science and technology policy and research and allocates funds for major S&T project, and the National Defense Science, Technology and Industry Commission, which manages and coordinates all military research and development programs (see figure). []

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At the research level, the reforms are breaking down barriers between what had been five essentially separate--and wasteful--research systems (the Chinese Academy of Sciences, the Ministry of Education, industrial ministries, national defense institutes, and provincial S&T organizations) by:

- Encouraging research institutes to forge links with production facilities. As state allocations for technology development decrease, research institutes are required to generate funds through contracts and consultancy arrangements with enterprises. Regulations issued in February 1987 require research institutes now subordinate to CAS, ministries, and provinces, to merge with major businesses and enterprise groups by 1990 so that technological results are readily available to industry.
- Formalizing cooperation between military and civilian research and production units through the transfer of military technology to civilian organizations, and using excess military production capacity for the production of civilian goods.

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KEY ELEMENTS OF CHINA'S S&T ESTABLISHMENT

LEADING GROUPS

S&T Leading Group

Leading Group for Invigoration of
the Electronics Industry

STATE COUNCIL COMMISSIONS

State Science and Technology
Commission

State Education Commission
State Economic Commission

National Defense
Science, Technology, and
Industry Commission

State Planning Commission

State Machine—Building Commission

RESEARCH ORGANIZATIONS

Chinese Academy of Sciences

Provincial S&T Institutes

Defense Ministries

Industrial Ministries

Educational Organizations



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- Promoting additional technology development and exchange activities through technology centers, fairs, and exhibits; new technology information services; and pilot programs to provide training and technical services to agriculture and rural industries.

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Funding

The reforms call for a decrease in government funding to research institutes involved in development and applied research between 1986-90 in order to push institutes to more technology development work. Institutes are beginning to acquire funds through contracts with industry, sales of research, and through new channels such as bank loans. The government will continue to fund key national projects--on a competitive basis--and research in the public interest such as public health and environmental research.

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The major mechanism for government funding of basic research is the new national natural science foundation, established in 1986 to fund basic research, as well as some applied research. Staffed by CAS, SSTC, and academic personnel, the foundation makes awards based on policy guidelines from the SSTC; project proposals are evaluated through peer review. It made its first awards in December, supporting 3400 projects for a total of 95 million yuan (\$25 million). Most of its awards are for small projects, but a few large-scale key projects are funded through the foundation as part of the effort to promote cooperation among researchers. Other, smaller specialized funds have also appeared. CAS, for example, will provide 3.5 million yuan in 1986 for basic science undertaken by young scientists.

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Chinese officials cite widely differing figures for research funding. One SSTC official said central government allocations to research in 1985 were 8.2 billion yuan, compared to 7.2 billion yuan in 1984; China's S&T White Paper says 9.5 billion yuan was spent on science research in 1984.² Other officials have said Beijing spent 1.4 billion on civilian research in 1985, with 11.5 billion to be allocated during the Seventh Five-Year Plan (1986-90). Chinese estimates of the percentage of the total research budget devoted to basic science vary from 5 to 12 percent.

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Evidence of Change

The Chinese press is full of glowing--and often contradictory--reports about the successes of the reforms:

² The current exchange rate is \$1= 3.8 yuan.

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- According to the S&T White Paper, defense industries in 1984 signed 6,800 contracts with civil units, for 430 million yuan; preliminary information for 1985 indicates 10,000 defense industry technologies worth about 1 billion yuan were transferred to civilian units.
- Nearly 10,000 cooperative agreements between research and production units have been signed since 1980 to bring together those who develop technology and those who need it.
- Over 22 percent of R&D organizations have established formal relationships with enterprises.
- Over 3,000 technology trade fairs were held in 1985.
- The volume of technology transfer by R&D organizations in 1985 reached 780 million yuan, according to one report; over 8 billion yuan, according to another.

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We believe China is encountering problems, however, in implementing the reforms. Research institutes are having difficulty adjusting to the need to sell their services or products, while production enterprises have limited resources to buy technology services. resisting the push to find outside funding. China has little experience with establishing prices or contracts for technology and consulting services, and some officials have been alarmed by such practices as plagiarizing technologies, deception, and fraud. Some managers have resisted the changes, on ideological grounds as well as out of jealousy that some S&T personnel are now permitted to earn extra income. Moreover, many of the technology transactions involve low-level technology related to daily life rather than more advanced innovations needed to promote industrial development. Chinese journals and foreign observers suggest that both buyer and seller often look for a technology that can be applied quickly and with little effort, avoiding advanced equipment and processes that require more effort to integrate into an existing facility.

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The reforms are also causing a reallocation of resources, with negative consequences, in our view. Beijing is overemphasizing market-oriented research on consumer goods, and shortchanging basic research needed to support innovation in the future. Similarly, S&T resources are being diverted from teaching responsibilities, raising the possibility that China's already weak educational system will increasingly be unable to provide an adequate supply of well-trained scientists and technicians.

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S&T Statistics

Selected S&T indicators for China's civil S&T system are attached (see Appendix A). China does not publish information on research in its defense industrial system. There are more than 200 research facilities under the national defense establishment, including some of the most advanced research facilities in China.

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Appendix A

China--Civilian S&T Statistics

China's recently published S&T White Paper contains statistics on its S&T system gathered in a nationwide survey during 1985. The following definitions were used in reporting the results.

- R&D organizations: Includes physical science, engineering, agriculture, and medicine; excludes organizations in education, industrial enterprises, and the national defense establishment.
- Scientists and engineers: personnel who have an educational level equivalent to a college undergraduate degree or higher, as well as other S&T personnel who have a senior middle school level education.

Total S&T Personnel, 1985

7.8 million natural scientists and technicians, which includes:

- 336,400 scientific researchers.
- 450,700 agricultural technicians.
- 1.4 million mathematicians.
- 2.2 million hygiene technicians.
- 3.4 million engineering technicians.

Of these, 45 percent are graduates of higher education, 41 percent are middle-level vocational school graduates.

Research Organizations

4,690 R&D organizations above the county level.

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- 770,000 employees, 231,000 (30 percent) are scientists and engineers; 45,000 (15 percent) are technicians.

Subordination of the 4,690 organizations:

- Chinese Academy of Sciences (CAS)--122 of the institutes (2.6 percent); 34,650 of the S&T personnel (15 percent)
- Ministries and commissions subordinate to the State Council--622 of the organizations (13 percent); 30,700 of the S&T personnel (13 percent)
- Municipalities and provinces: 3,946 of the organizations (84 percent); 165,650 of the S&T personnel (72 percent)

3,268 R&D organizations subordinate to the county level.

- Of 77,000 county employees, about 5,000 have reached educational levels above college undergraduate.

S&T Publications, 1985

92 S&T publishers

- 53 belong to Specialist S&T Publishing House, a central publishing system; 28 local S&T publishers; 11 universities.

2,641 S&T journals published (1,038 by central publishers; 1,423 by local ones)

Patents

China's patent law went into force on 1 April 1985.

- 1985 (9 months): 14,372 patent applications received; 143 approved.
-- 66 percent domestic, 34 percent foreign.
- 1986: 18,509 applications received; 3,164 granted.

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-- 74 percent domestic, 26 percent foreign

International S&T Activities, 1985

Government

- S&T relations with 106 countries.
- S&T cooperation agreements with 54 countries.
- Participation in 250 international S&T organizations.

Nongovernmental

- CAST belongs to 106 international nongovernmental S&T organizations.
- 300 Chinese S&T personnel hold leading posts in international S&T organizations.
- 41,000 Chinese S&T personnel sent abroad on exchanges.
- 50,000 foreign delegates received.

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